

## WHAT IS CLAIMED IS:

1           1.     A method for reducing errors during data processing, comprising:  
 2           testing at least one number resulting from an incremental calculation of  
 3     transform coefficients during a transform;  
 4           determining whether to perform a corrective action based upon the testing;  
 5     and  
 6           performing the corrective action when a corrective action is determined to be  
 7     needed.

1           2.     The method of claim 1 wherein the determining comprises detecting  
 2     whether the incremental calculation of the transform coefficients will result in  
 3     transform coefficients with unacceptable precision and the performing corrective  
 4     action comprises refining the at least one number.

1           3.     The method of claim 2 wherein the transform comprises a transform  
 2     matrix and wherein the refining comprises applying a refinement matrix for  
 3     increasing precision of the incremental calculation of the transform constants.

1           4.     The method of claim 3 wherein the refinement matrix comprises  
 2      $I + {}_d D_{m+1} D_m^{-1}$ .

1           5.     The method of claim 1 further comprising generating at least one  
 2     refinement matrix based on approximately calculated transform constants.

6. The method of claim 5 wherein the generating at least one refinement matrix is performed offline or at initialization.

7. The method of claim 5 wherein the generating the at least one refinement matrix comprises recognizing that an approximate transform is invertible, generating the refinement matrix given by  $I + {}_dD_{m+1} D_m^{-1}$ , and structuring the transform for efficient computation.

8. The method of claim 5 wherein the generating the at least one refinement matrix comprises:

- recognizing that recovery of the nth column of a transform matrix for generating the transform is impossible;
- calculating a pseudo inverse for a portion of the transform matrix; and
- generating an approximation for the at least one refinement matrix using the pseudo inverse for the transform matrix.

9. The method of claim 8 wherein the approximation of the refinement matrix comprises  $I + {}_dD_{1d} \tilde{D}_0$ .

10. The method of claim 1 wherein the determining whether to perform a corrective action further comprises determining whether an error resulting from terminating the incremental calculation is acceptable and the performing corrective action comprises aborting the incremental calculation of a transform coefficient.

1           11.    The method of claim 10 wherein the incremental calculation is  
2 terminated when a determination is made that the incremental calculation will result  
3 in a number that is projected to be within a predetermined range.

1           12.    The method of claim 11 wherein the number that is projected to be  
2 within a predetermined range comprises a transform coefficient that does satisfy a  
3 precision requirement.

1           13.    The method of claim 11 wherein the incremental calculation is  
2 terminated when a refinement to the transform coefficient is determined not to  
3 change the result.

1           14.    The method of claim 13 wherein a refinement to the transform  
2 coefficient is determined not to change the result when, after checking the relative  
3 magnitudes of the results of the incremental calculations, an intermediate calculation  
4 of at least one transform coefficient is small compared to the intermediate calculation  
5 of another transform coefficient.

1           15.    The method of claim 13 wherein a refinement to the transform  
2 coefficient is determined not to change the result when, after checking the  
3 magnitude of the results of at least one incremental calculation, at least one  
4 intermediate calculation of the transform coefficient is less than a predetermined  
5 threshold.

- 1           16.    The method of claim 1 wherein the determining further comprises  
2   determining that a transform coefficient is going to be within a predetermined range  
3   of zero and the performing corrective action comprises aborting the incremental  
4   calculation of the transform coefficient.

1           17.    A printer, comprising:  
 2           memory for storing image data;  
 3           a processor for processing the image data to provide a print stream output;  
 4    and  
 5           a printhead driving circuit for controlling a printhead to generate a printout of  
 6    the image data;  
 7           wherein the processor reduces errors of the transform by testing at least one  
 8    number resulting from an incremental calculation of transform coefficients during a  
 9    transform, determining whether to perform a corrective action based upon the testing  
 10   and performing the corrective action when a corrective action is determined to be  
 11   needed.

1           18.    The printer of claim 17 wherein the processor determines whether to  
 2   perform a corrective action by detecting whether the incremental calculation of the  
 3   transform coefficients will result in transform coefficients with unacceptable precision  
 4   and performs corrective action by refining the at least one number.

1           19.    The printer of claim 18 wherein the transform comprises a transform  
 2   matrix and wherein the transformer refines the at least one number by applying a  
 3   refinement matrix for increasing precision of the incremental calculation of the  
 4   transform constants.

1           20.    The printer of claim 19 wherein the refinement matrix comprises

2    $I + {}_d D_{m+1} \ D_m^{-1}$ .

1           21.    The printer of claim 19 wherein the refinement matrix is based on  
2   approximately calculated transform constants.

1           22.    The printer of claim 21 wherein the refinement matrix is generated  
2   offline or at initialization.

1           23.    The printer of claim 20 wherein the refinement matrix is generated by  
2   recognizing that an approximate transform is invertible, generating the refinement  
3   matrix given by  $I + {}_dD_{m+1} D_m^{-1}$ , and structuring the transform for efficient computation.

1           24.    The printer of claim 20 wherein the refinement matrix is generated by  
2   recognizing that recovery of the nth column of a transform matrix for generating the  
3   transform is impossible, calculating a pseudo inverse for a portion of the transform  
4   matrix and generating an approximation for the refinement matrix using the pseudo  
5   inverse for the transform matrix.

1           25.    The printer of claim 24 wherein the approximation of the refinement  
2   matrix comprises  $I + {}_dD_{1d} \tilde{D}_0$ .

1           26.    The printer of claim 17 wherein the transformer determines whether to  
2   perform a corrective action by determining whether an error resulting from  
3   terminating the incremental calculation is acceptable and performs corrective action  
4   by aborting the incremental calculation of a transform coefficient.

1           27.    The printer of claim 26 wherein the transformer terminates the  
2    incremental calculation when a determination is made that the incremental  
3    calculation will result in a number that is projected to be within a predetermined  
4    range.

1           28.    The printer of claim 27 wherein the number that is projected to be  
2    within a predetermined range comprises a transform coefficient that does satisfy a  
3    precision requirement.

1           29.    The printer of claim 27 wherein the transformer terminates the  
2    incremental calculation when a refinement to the transform coefficient is determined  
3    not to change the result.

1           30.    The printer of claim 29 wherein the transformer determines that a  
2    refinement to the transform coefficient will not change the result when, after  
3    checking the relative magnitudes of the results of the incremental calculations, an  
4    intermediate calculation of at least one transform coefficient is small compared to the  
5    intermediate calculation of another transform coefficient.

1           31.    The printer of claim 29 wherein the transformer determines that a  
2    refinement to the transform coefficient will not change the result when, after  
3    checking the magnitude of the results of at least one incremental calculation, at least  
4    one intermediate calculation of the transform coefficient is less than a predetermined  
5    threshold.

1           32.    The printer of claim 17 wherein the transformer determines that a  
2   corrective action is to be determined by determining that a transform coefficient is  
3   going to be within a predetermined range of zero and performs corrective action by  
4   aborting the incremental calculation of the transform coefficient.

1           33.    An article of manufacture comprising a program storage medium  
2   readable by a computer, the medium tangibly embodying one or more programs of  
3   instructions executable by the computer to perform a method for reducing errors  
4   during data processing, the method comprising:

5           testing at least one number resulting from an incremental calculation of  
6   transform coefficients during a transform;

7           determining whether to perform a corrective action based upon the testing;  
8   and

9           performing the corrective action when a corrective action is determined to be  
10   needed.

1           34.    The article of manufacture of claim 33 wherein the determining  
2   comprises detecting whether the incremental calculation of the transform coefficients  
3   will result in transform coefficients with unacceptable precision and the performing  
4   corrective action comprises refining the at least one number.

1           35.    The article of manufacture of claim 34 wherein the transform  
 2   comprises a transform matrix and wherein the refining comprises applying a  
 3   refinement matrix for increasing precision of the incremental calculation of the  
 4   transform constants.

1           36.    The article of manufacture of claim 35 wherein the refinement matrix  
 2   comprises  $I + {}_dD_{m+1} D_m^{-1}$ .

1           37.    The article of manufacture of claim 33 further comprising generating at  
 2   least one refinement matrix based on approximately calculated transform constants.

1           38.    The article of manufacture of claim 37 wherein the generating at least  
 2   one refinement matrix is performed offline or at initialization.

1           39.    The article of manufacture of claim 37 wherein the generating the at  
 2   least one refinement matrix comprises recognizing that an approximate transform is  
 3   invertible, generating the refinement matrix given by  $I + {}_dD_{m+1} D_m^{-1}$ , and structuring  
 4   the transform for efficient computation.

1           40.    The article of manufacture of claim 37 wherein the generating the at  
 2   least one refinement matrix comprises:  
 3           recognizing that recovery of the nth column of a transform matrix for  
 4   generating the transform is impossible;  
 5           calculating a pseudo inverse for a portion of the transform matrix; and  
 6           generating an approximation for the at least one refinement matrix using the  
 7   pseudo inverse for the transform matrix.

1           41.    The article of manufacture of claim 40 wherein the approximation of  
 2   the refinement matrix comprises  $I + {}_dD_{1d}\tilde{D}_0$ .

1           42.    The article of manufacture of claim 33 wherein the determining  
 2   whether to perform a corrective action further comprises determining whether an  
 3   error resulting from terminating the incremental calculation is acceptable and the  
 4   performing corrective action comprises aborting the incremental calculation of a  
 5   transform coefficient.

1           43.    The article of manufacture of claim 42 wherein the incremental  
 2   calculation is terminated when a determination is made that the incremental  
 3   calculation will result in a number that is projected to be within a predetermined  
 4   range.

1           44.    The article of manufacture of claim 43 wherein the number that is  
2   projected to be within a predetermined range comprises a transform coefficient that  
3   does satisfy a precision requirement.

1           45.    The article of manufacture of claim 43 wherein the incremental  
2   calculation is terminated when a refinement to the transform coefficient is  
3   determined not to change the result.

1           46.    The article of manufacture of claim 45 wherein a refinement to the  
2   transform coefficient is determined not to change the result when, after checking the  
3   relative magnitudes of the results of the incremental calculations, an intermediate  
4   calculation of at least one transform coefficient is small compared to the intermediate  
5   calculation of another transform coefficient.

1           47.    The article of manufacture of claim 45 wherein a refinement to the  
2   transform coefficient is determined not to change the result when, after checking the  
3   magnitude of the results of at least one incremental calculation, at least one  
4   intermediate calculation of the transform coefficient is less than a predetermined  
5   threshold.

1           48.    The article of manufacture of claim 33 wherein the determining further  
2   comprises determining that a transform coefficient is going to be within a  
3   predetermined range of zero and the performing corrective action comprises  
4   aborting the incremental calculation of the transform coefficient.

1           49.    A data analysis system, comprising;  
 2           transform equations formed by testing at least one number resulting from an  
 3    incremental calculation of transform coefficients during a transform, determining  
 4    whether to perform a corrective action based upon the testing and performing the  
 5    corrective action when a corrective action is determined to be needed; and  
 6           a transformer for applying the transform equations to perform a linear  
 7    transform to decorrelate data into transform coefficients.

1           50.    The data analysis system of claim 49 wherein the transformer  
 2    determines whether to perform a corrective action by detecting whether the  
 3    incremental calculation of the transform coefficients will result in transform  
 4    coefficients with unacceptable precision and performs corrective action by refining  
 5    the at least one number.

1           51.    The data analysis system of claim 50 wherein the transform comprises  
 2    a transform matrix and wherein the transformer refines the at least one number by  
 3    applying a refinement matrix for increasing precision of the incremental calculation of  
 4    the transform constants.

1           52.    The data analysis system of claim 51 wherein the refinement matrix  
 2    comprises  $I +_d D_{m+1} D_m^{-1}$ .

1           53.    The data analysis system of claim 51 wherein the refinement matrix is  
 2    based on approximately calculated transform constants.

1           54.    The data analysis system of claim 53 wherein the refinement matrix is  
2 generated offline or at initialization.

1           55.    The data analysis system of claim 52 wherein the refinement matrix is  
2 generated by recognizing that an approximate transform is invertible, generating the  
3 refinement matrix given by  $I + {}_dD_{m+1} {}_mD_m^{-1}$ , and structuring the transform for efficient  
4 computation.

1           56.    The data analysis system of claim 52 wherein the refinement matrix is  
2 generated by recognizing that recovery of the nth column of a transform matrix for  
3 generating the transform is impossible, calculating a pseudo inverse for a portion of  
4 the transform matrix and generating an approximation for the refinement matrix  
5 using the pseudo inverse for the transform matrix.

1           57.    The data analysis system of claim 56 wherein the approximation of the  
2 refinement matrix comprises  $I + {}_dD_1 {}_d\tilde{D}_0$ .

1           58.    The data analysis system of claim 49 wherein the transformer  
2 determines whether to perform a corrective action by determining whether an error  
3 resulting from terminating the incremental calculation is acceptable and performs  
4 corrective action by aborting the incremental calculation of a transform coefficient.

1           59.    The data analysis system of claim 58 wherein the transformer  
2 terminates the incremental calculation when a determination is made that the  
3 incremental calculation will result in a number that is projected to be within a  
4 predetermined range.

1           60.    The data analysis system of claim 59 wherein the number that is  
2 projected to be within a predetermined range comprises a transform coefficient that  
3 does satisfy a precision requirement.

1           61.    The data analysis system of claim 59 wherein the transformer  
2 terminates the incremental calculation when a refinement to the transform coefficient  
3 is determined not to change the result.

1           62.    The data analysis system of claim 61 wherein the transformer  
2 determines that a refinement to the transform coefficient will not change the result  
3 when, after checking the relative magnitudes of the results of the incremental  
4 calculations, an intermediate calculation of at least one transform coefficient is small  
5 compared to the intermediate calculation of another transform coefficient.

1           63.    The data analysis system of claim 61 wherein the transformer  
2 determines that a refinement to the transform coefficient will not change the result  
3 when, after checking the magnitude of the results of at least one incremental  
4 calculation, at least one intermediate calculation of the transform coefficient is less  
5 than a predetermined threshold.

1           64.    The data analysis system of claim 49 wherein the transformer  
2 determines that a corrective action is to be determined by determining that a  
3 transform coefficient is going to be within a predetermined range of zero and  
4 performs corrective action by aborting the incremental calculation of the transform  
5 coefficient.